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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/981,390	10/18/2001	Yuichi Naitou	NEC-472-US	7712

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EXAMINER
JOHNSTON, PHILLIP A

ART UNIT	PAPER NUMBER
2881	

DATE MAILED: 02/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/981,390	NAITOU ET AL.
	Examiner	Art Unit
	Phillip A Johnston	2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-78* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-78* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 October 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

Detailed Action

Claims Rejection – 35 U.S.C. 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-19,31,32,43,44,48, and 49, are rejected under 35 U.S.C. 102(b) as being clearly anticipated by U.S. Patent No. 5,990,477, to Tomita.

Tomita (477) clearly discloses a scanning probe microscope that includes a probe 1, a vibration application portion consisting of a piezoelectric vibrating body 2 and an AC voltage-generating means 3, a vibration-detecting portion consisting of a quartz oscillator 4 and a current/voltage amplifier circuit 5, a coarse displacement means 6 for bringing the probe close to the sample surface, a sample-to-probe distance control means consisting of a Z fine displacement element 11 and a Z servo circuit 12, a two-dimensional scanning means consisting of an XY fine displacement element 13 and an XY scanning circuit 14, and a data-processing means 15 for converting a measurement signal into a three-dimensional image. A resilient body 16 produces spring pressure that holds the probe 1 to the quartz oscillator 4. When the probe vibrating horizontally is brought close to the sample surface, a shear force acts

on the tip of the probe. This reduces the amplitude of the vibration. The probe and the quartz oscillator are secured together by spring pressure and thus operate as a unit. Therefore, the decrease in the amplitude of the vibration of the probe results in a decrease in the amplitude of the vibration of the quartz oscillator. This in turn reduces the output current, which is detected by the current/voltage amplifier circuit. The distance between the sample and the probe is controlled with the Z fine displacement element and the Z servo circuit to maintain the output current from the quartz oscillator constant. In this way, the tip of the probe is kept at a constant distance from the sample surface. Under this condition, the probe is scanned in two dimensions across the sample plane to produce a three-dimensional image. See Column 3, line 47-67, and Column 4, line 1-10.

Tomito (477) also discloses that a quartz oscillator 4 and a piezoelectric oscillator 2 are bonded to a quartz oscillator holder 25 with adhesive. A PZT device in the form of a flat plate is used as the piezoelectric oscillator. When an AC voltage is applied to the PZT device, it vibrates, forcing the quartz oscillator to vibrate. If the vibration frequency is made coincident with the resonant frequency (e.g., 32.7 kHz) of the quartz oscillator, the quartz oscillator resonates. Then, piezoelectric effect induces an electric charge on the electrodes of the quartz oscillator. The resulting current, is detected by a current/voltage amplifier circuit. Since a current proportional to the amplitude of the vibration of the quartz oscillator is produced, the state of the vibration of the quartz oscillator can be measured from the detected current. A probe 1 is held to the quartz oscillator by spring pressure of a resilient body 16. The used probe is

prepared by chemically etching the tip of tungsten and machining it into a tapering form. The probe can be made of metals in this way. See Column 4, line 51-67, and Column 5, line 8-12.

Tomita (477) further discloses that the sample is held in a vacuum, using a vacuum chamber 18. In this way, the sample can be retained in a vacuum. The vacuum chamber may be provided with a gas inlet port, and the sample may be exposed to an inert gas or reactive gas. Under this condition, an electric field, magnetic field, electric current, light, heat, pressure, or the like was applied from the tip of the probe to the sample surface, as recited in Claims 31,32,48, and 49. See Column 5, line 65-67, and Column 6, line 1-5.

Claims Rejection – 35 U.S.C. 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 20-30, 33-42, 45-47, and 50-78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomita (477), as applied above to Claims 1-9,31,32,43,44,48, and 49, and in further view of Adderton (506).

Regarding Claims 20-23, Tomita (477), as applied above to Claims 1-19,31,32,43,44,48, and 49 discloses a scanning probe microscope apparatus and method that includes nearly all the limitations of Claims 20-23, but does not include the use of "a diode detector for detecting the probe signal", or "a characteristic signal that shows a capacitance between the probe and the sample" . Adderton (506); however discloses scanning capacitance microscope wherein a surface of the sample is scanned in intermittent contact mode with an the AFM. The probe tip is electrically conductive and is electrically connected to a capacitance sensing circuit. The oscillation of the AFM probe modulates capacitance between probe tip and sample surface. The modulated capacitance is demodulated to yield the capacitance properties of the sample. See the Abstract. Also, the amplitude of the signal is detected and outputted from the capacitance sensing circuit as a signal corresponding to the tip-sample capacitance, plus any parasitic capacitance. Other types of capacitive sensors, e.g. capacitive bridge circuits and impedance transformers, may also be used. See Column 1, line 65-67, and Column 2, line 1-4.

It is implied herein that the use of capacitive sensors in accordance with Adderton (506) is equivalent to the use of a "diode detector for detecting an output signal" as recited in Claims 20-23.

Therefore, it would have been obvious to one of ordinary skill in the art that one could design a scanning probe according to Tomita (477) and use capacitive sensors to detect the capacitance between the probe and the sample in accordance with the teaching of Adderton (506).

Regarding Claims 24-30, 33-42, 45-47, and 50-78, Tomita (477), in view of Adderton as applied above to Claims 1-23,31,32,43,44,48, and 49 discloses a scanning probe microscope apparatus and method that includes nearly all the limitations of Claims 24-30, 33-42, 45-47, and 50-78 but does not include the use of "a characteristic signal that shows a differential component of capacitance and current", or " a calculating unit for calculating a differential component". Adderton (506); however, discloses that the amplitude of the capacitance modulation signal results from the electrical series combination of the modulated air gap capacitance, i.e. the capacitance between the tip and sample, and the substantially unmodulated capacitance of the sample surface, i.e. the sample capacitance. The signal amplitudes are demodulated, preferably at the frequency of the probe tip oscillation, or tapping, producing signals corresponding to the oscillation amplitude of the tip-sample capacitance. Alternatively, modulation at harmonics of the oscillation, or mixing of multiple oscillation frequencies, may be used. The demodulated capacitance signals may be stored, and may also be displayed as an image representative of the tip-sample capacitance as it varies across the sample surfaces. Such images may, for example, represent variations in carrier or impurity concentrations across semiconductor samples, or variations in the capacitance across a dielectric layer on the surface of a semiconductor sample or a conductor sample. Variations in dielectric capacitance may correspond to intrinsic properties such as trapped charge or dielectric constant or variation in thickness. See Column 1, line 40-67, and Column 2, line 1-20.

Adderton (506) also teaches in FIG. 1 an AFM including probe tip oscillator 1 that oscillates cantilever 2 and conductive probe tip 3 (collectively "probe 15"). Probe 15 may be magnetic, and can be oscillated by a magnetic actuator. Probe 15 moves toward and away from the surface of sample 4 in oscillatory motion, preferably at or near a resonant frequency of probe 15. Conductive probe tip 3 is electrically connected to UHF capacitance sensor 6 via path 11. From sensor 6, modulated capacitance signals, corresponding to variations in the tip-sample system capacitance, pass on path 13 to lock-in amplifier 7. Lock-in amplifier 7 demodulates the capacitance signals at the oscillation frequency, or at some combination of frequency oscillation harmonics, of probe 15, resulting in signals that correspond to the modulation amplitude of the tip-sample capacitance. These signals pass on path 14 to control and computer 8. Signals on path 14 pass into AFM computer control electronics 8 to be stored for each data point with respect to X and Y position on sample 4. Such data may also be passed to display device 12 for display as an image of sample capacitance(s) on or across sample 4. This display could also show, simultaneously or otherwise, a topographic image of sample 4 obtained from the motion of probe 15. See Column 2, line 53-67, and Column 3, line 1-16.

It is implied herein that the use of modulated capacitance signals detected by a lock-in amplifier in accordance with Adderton (506), is equivalent to detecting and calculating the "first differential component of capacitance and current" as recited in Claims 24-30, and 36-42.

It is also implied herein that the use of modulated capacitance signals, then detecting the demodulated signal at the oscillation frequency with a lock-in amplifier in accordance with Adderton (506), is equivalent to detecting and calculating the "second differential component of capacitance and current" as recited in Claims 24-30, and 36-42.

Therefore, it would have been obvious to one of ordinary skill in the art that the Tomita (477) scanning probe apparatus and method could be modified with the modulated and demodulated capacitance signals representative of the tip-sample capacitance as it varies across the sample surfaces, in accordance with the teaching of Adderton (506), to extend the applicability of the Tomita (477) invention to detect variations in carrier or impurity concentrations across semiconductor samples, if so desired.

Conclusion

5. Any inquiry concerning this communication or earlier communications should be directed to Phillip Johnston whose telephone number is (703) 305-7022. The examiner can normally be reached on Monday-Friday from 7:30 am to 4:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiners supervisor John Lee can be reached at (703) 308-4116. The fax phone numbers are (703) 872-9318 for regular response activity, and (703) 872-9319 for after-final responses. In addition the customer

service fax number is (703) 872- 9317.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

PJ
February 5, 2003

JOHN R. LEE
SUPERVISORY PATENT EXAMINER
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